Herbicidal properties of Portuguese propolis samples

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Propolis is a natural product made by honeybees (*Apis mellifera* L.) with important physical and biological protective functions, being used to maintain hive integrity, as well as adequate thermal and sanitary conditions. It is a complex mixture made essentially from collected plant exudates, being composed of waxes, resins, balsams, pollen, essential oils, and other organic and mineral compounds. It has a high plant source-dependent chemical variability and more than 300 constituents were already identified. Over the last decades, several biological and pharmacological properties have been identified in propolis, namely antiviral, antibacterial, antifungal, antiprotozoan, anti-inflammatory, antitumor, cytostatic, antioxidant but, so far, no phytotoxic properties were reported. The principal compounds responsible for propolis bioactivities are flavonoids and phenolic compounds, but very often different propolis types have distinct main bioactive compounds.

Propolis value is still poorly acknowledged by the Portuguese beekeepers, generally constituting a by-product that is discarded during hive management, and only recently Portuguese propolis has started to be investigated. It is our goal to contribute to the evaluation of its chemical diversity and biological activities. The study here reported concerns specifically with the evaluation of propolis phytotoxic effects envisaging its potential economic valorization as a bioherbicide.

Phytotoxic effects of *n*-hexane (HE) and ethanol (EE) extracts obtained from propolis samples collected in two apiaries (Côa – C, Pereiro - P) in the east-central region of Portugal, were tested in plantlets of flax (*Linum usitatissimum* L.) grown *in vitro*. Results shown that both samples and types of extracts impaired plant growth but specific differences were detected: all treatments inhibited root growth but P samples, in particular HE.P, were much more effective than C ones, and while HE did not affect

epicotyl and hypocotyl growth, EE, in particular EE.P, strongly inhibited their growth. Total polyphenols and flavonoids quantification revealed that EE.P has higher contents than EE.C, but, due to the low content of such compounds in H extracts, the effect on root growth must be caused by other type of compound. The present work allowed concluding that propolis present strong phytotoxic effects and that there are significant differences among samples even from close geographical regions.

Keywords: Propolis, phytotoxicity, in vitro plant development.